REMARKS

This Amendment is in response to the Office Action dated September 16, 2009, in which claims 1, 3-8, and 10 were allowed, claims 11-13, 15, 16, and 27-29 were rejected, claim 14 was objected to but indicated as containing allowable subject matter, and claims 17-24 were withdrawn from consideration as being drawn to a nonelected species. With this Amendment, claims 11-15, 27, and 28 are amended. Claims 1, 3-8, 10-24, and 27-29 are in condition for allowance, and notice to that effect is requested.

The Invention

The invention, as recited in each of the independent claims, is directed to a magnetic sensor (independent claims 1 and 27) or a magnetoresistive read head (claim 11) in which an electric field E is applied in a direction generally transverse to the direction in which sense current I_s flows through a sensor stack (claims 1 and 27) or a magnetoresistive stack (claim 11). The electric field E reduces the area through which sense current I_s can flow--i.e. it confines the sense current I_s to a smaller area than the physical area of the stack. Depending upon the orientation of the electric field, the electrical width w_e of the stack (i.e., the width of the stack through which sense current can flow) can be made smaller than the physical width w_p of the stack, or the electrical stripe height h_e of the stack can be made smaller than the physical stripe height h_p. Making the electrical width w_e smaller increases resolution of the magnetic sensor or magnetic read head. Reducing the electrical stripe height h_e increases the sensitivity of the magnetic sensor or magnetic read head.

The principles of this invention are illustrated by FIGS. 1a and 2a.

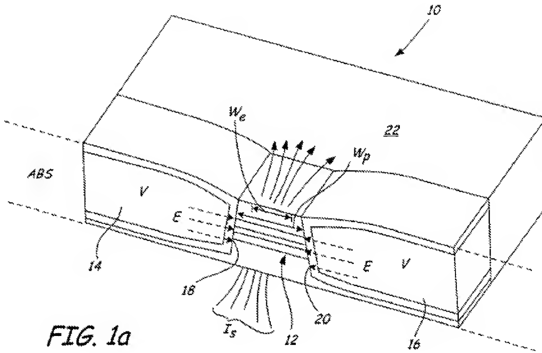

FIG. 1a

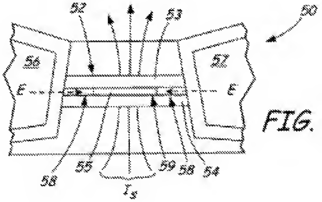

FIG. 2a

Magnetic sensor 10 in FIG. 1a has a physical width w_p and a corresponding electrical width w_e and has a physical height or stripe height h_p and a corresponding electrical height h_e. (Application, page 6, line 1 to page 8, line 8). The magnetic sensor also includes bias electrodes 14,

16 generating electric fields E in a direction generally transverse to a direction of flow of sense current I_s through sensor stack 12 to create a charge carrier depleted region in the sensor stack. (Application, page 6, line 1 to page 8, line 8). Examples of charge carrier depleted regions are shown in FIG. 2a as regions 58 that are produced by electrical fields E from bias electrodes 56 and 57 (which are similar to bias electrodes 14 and 16). (Application, page 9, line 5 to page 11, line 4). The charge carrier depleted regions also can be seen in FIG. 1a as the portions of the physical width w_p that are outside of the electrical width w_e and the portions of the physical height h_p that are outside of the electrical height h_e.

In FIG. 1, the charge carrier depleted regions in sensor stack 12 are created by electrical fields E from bias electrodes 14 and 16 and cause the electrical width w_e to be smaller than the physical width w_p. Bias electrodes 14 and 16 are separated from sensor stack 12 by dielectric layers 18 and 20. Thus the voltage V applied to bias electrodes 14, 16 does <u>not</u> produce a horizontal current in sensor stack 12 between bias electrodes 14, 16. Instead, voltage V creates electric fields E, which move electrons (the charge carriers) out of the portions of stack 12 near dielectric layers 18, 20 to create the charge carrier depleted regions. Thus sense current I_s in FIG. 1a is confined to the center portion of stack 12 having width w_e. (Application, page 6, lines 1-18).

Independent claims 11 and 27 have been amended to include a dielectric layer that separates each electrode that generates an electric field in a direction generally transverse or perpendicular to a direction of sense current flow through the sensor stack. For example, independent claim 11 has been amended to recite "a first bias electrode separated from the magnetoresistive stack by a first dielectric layer...." Similarly, claim 27 has been amended to recite "at least one electrode separated from the sensor stack by a dielectric layer...."

<u>Rejections of claims 27-29</u>

Claims 27-29 were rejected under 35 U.S.C. § 102(b) as being unpatentable over Funayama (U.S. 2002/0097533).

Funayama describes a current perpendicular to plane (CPP) type magnetoresistive device that includes magnetoresistive film 1, top and bottom electrodes 2 and magnetic biasing films 3. Top and bottom electrodes 2 are positioned on the top and bottom surfaces of magnetic film 1, so

that the sense current through the magnetoresistive device flows in a direction perpendicular to the plane of film 1. Biasing films 3 are positioned on opposite sides of film 1 to apply a biasing <u>magnetic</u> field to magnetoresistive film 1 in a direction parallel to the film plane. The general construction of the magnetoresistive device is illustrated in FIGS. 22-24. Also shown in FIG. 24 are magnetic shields 4 and insulation film 6. The numbered parts in FIGS. 22-24 on the following page have also been labeled with their names in italics.

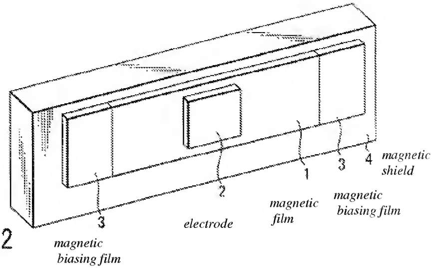

FIG. 22

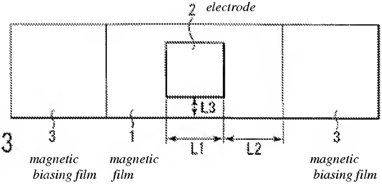

FIG. 23

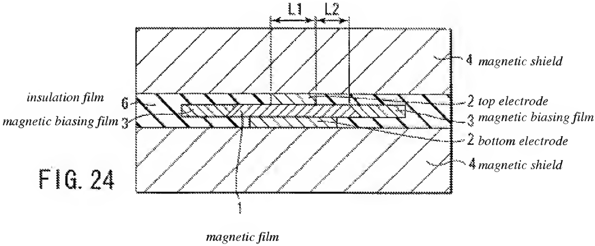

FIG. 24

(Italics added).

Funayama describes a device in which electrodes 2 are recessed from the air bearing surface (ABS). This is shown in FIG. 3.

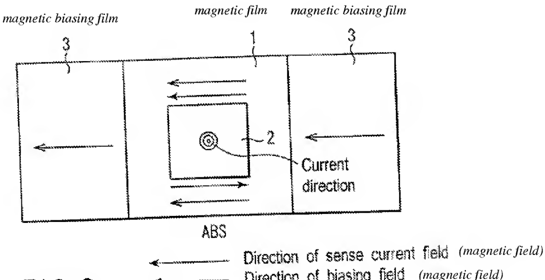

FIG. 3

(Italics added).

As amended, independent claim 27 reads as follows:

27. A magnetic sensor comprising:

a sensor stack; and

at least one **electrode separated from the sensor stack by a dielectric layer** and configured to **generate an electric field generally perpendicular to a direction of sense current flow through the sensor stack** to produce a charge carrier-depleted region in the magnetic sensor that confines the sense current to a smaller area in the magnetic sensor.

(Emphasis added).

Funayama does not show "at least one electrode separated from the sensor stack by a dielectric layer and configured to generate an electric field generally perpendicular to a direction of

sense current flow through the sensor stack", as required by independent claim 27. Funayama shows two electrodes: top electrode 2 and bottom electrode 2. As shown in FIG. 24, the top and bottom electrodes 2 are directly in contact with magnetic film 1. They are not separated from the sensor stack by a dielectric layer. Nor do top and bottom electrodes 2 of Funayama generate an electric field generally perpendicular to the direction of sense current flow. In fact, electrodes 2 cause a sense current to flow through magnetic film 1 which produces a magnetic field perpendicular to the direction of sense current flow--not an electric field. Nor does Funayama teach the creation of a charge carrier depleted region in a magnetic sensor produced by an electrode separated from the sensor stack by a dielectric layer, as required by claim 27.

Funayama does not teach or suggest the present invention, as defined in independent claim 27 and dependent claims 28 and 29. Funayama does not anticipate independent claim 27 and dependent claims 28-29, as amended, and the rejection under 35 U.S.C. § 102(b) should be withdrawn.

Rejection of claims 11-13, 15, and 16

In the Office Action, claims 11-13, 15, and 16 were rejected under 35 U.S.C. § 102(e) as being anticipated by Kadokawa (U.S. Patent No. 6,661,627).

Kadokawa does not teach generation of an electric field in a direction generally transverse to direction of sense current flow through the sensor stack, and does not teach the use of an electric field to create a charge carrier depleted region in order to create an electrical width (i.e. read width) that is smaller than the physical width. Kadokawa reduces track width (i.e. read width) with a magnetic field parallel to the direction of sense current flow. The structure and the physical effect used by Kadokawa is different than the invention defined in claims 11, 13, 15, and 16.

With respect to claim 11, the Office Action states:

> Kadokawa shows in figure 5 a magnetoresistive read head includes a magnetoresistive stack 1; and a first bias electrode 3 positioned with respect to the magnetoresistive stack to generate an electric field in a direction generally transverse to a direction of sense current flow through the sensor stack 1 such that a read width of the magnetoresistive stack is a function of a bias voltage applied to the first bias electrode 3.

FIG. 5 of Kadokawa shows:

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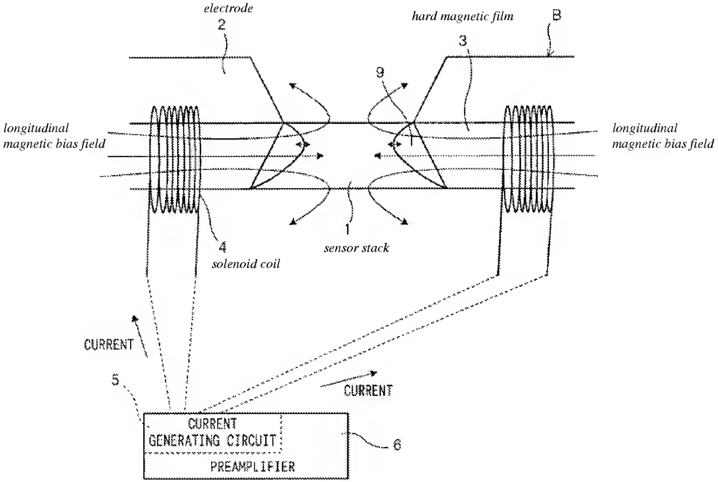

(Italics added).

Claim 11 as amended reads as follows:

11. A magnetoresistive read head comprising:

a magnetoresistive stack; and

a **first bias electrode separated from the magnetoresistive stack by a first dielectric layer** and positioned with respect to the magnetoresistive **stack to generate an electric field in a direction generally transverse to a direction of sense current flow through the magnetoresistive stack** such that a read width of the magnetoresistive stack is a function of a bias voltage applied to the first bias electrode.

(Emphasis added).

Element "3" shown in FIG. 5 (and FIG. 2) of Kadokawa is identified as a hard magnetic film, not an electrode as stated in the Office Action. It is element 2 that is referred to by Kadokawa as an electrode.

In either case, neither electrodes 2 nor hard magnetic films 3 are a first bias electrode separated from the magnetoresistive stack by a first dielectric layer. There is no dielectric layer separating electrode 2 from sensor stack 1. Nor is there a dielectric layer that separates hard magnetic film 3 from sensor stack 1.

Kadokawa fails to disclose the present invention, as defined in amended independent claim 11 for several reasons:

First, it does not use a first bias electrode, separated from the magnetoresistive stack by a first dielectric layer, to generate an electric field in a direction generally transverse to the direction of sense current flow through the magnetoresistive stack. The electrodes 2 shown in Kadokawa are not separated from stack 1 by dielectric layers.

Second, Kadokawa does not generate an electric field in a direction generally transverse to the direction of sense current flow through the sensor stack.

Third, Kadokawa does not generate an electric field that causes the read width to be a function of voltage applied to a first bias electrode separated from the magnetoresistive stack by a first dielectric layer.

Fourth, the field used by Kadokawa to adjust read width is a magnetic field in the same direction as the sense current flow between electrodes 2 located on opposite sides of the sensor

stack--not an electric field generally transverse to the direction of sense current flow as defined in independent claim 11.

Claims 11-13, 15 and 16 are not anticipated by Kadokawa. The rejection under 35 U.S.C. § 102(e) should be reconsidered and withdrawn.

Objection to Claim 14

The Office Action objected to claim 14 as being dependent from a rejected base claim. It indicated that claim 14 would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims. Claim 14 depends from independent claim 11 through dependent claims 12 and 13. Because claim 11 as well as claims 12 and 13 are in condition for allowance, claim 14 is as well.

Withdrawn Claims 17-24

Claims 17-24 all depend directly or indirectly from independent claim 11. These claims have been indicated as withdrawn. However, because independent 11 is in condition for allowance, claims 17-24 are also in condition for allowance. The status of those claims should be changed and they should be allowed.

Conclusion

In view of the foregoing, it is respectfully requested that the rejections of claims 11-13, 15, 16, and 27-29 and the objection to claim 14 be withdrawn, and that all pending claims 1, 3-8, 10-24, and 27-29 be allowed.

The Commissioner is hereby authorized to charge any additional fees which may be required under 37 C.F.R. 1.16 and 1.17, or credit any overpayment, to Deposit Account No. 11-0982.

Respectfully submitted,

KINNEY & LANGE, P.A.

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